CONSOLIDATED INFORMATION TECHNOLOGY SERVICES
TASK ASSIGNMENT (TA)

1. **TITLE:** (D204) Avalanche Photodiode Detector (APD) Module Integration & Demo Support

TA No:	220-Rev1		
Task Area Monitor:	**Alternate Task Area Monitor:**		None
NASA POC:	None	**Software Control Class:**	Low Control
Type of Task:	Non-Recurring Task		

2. BACKGROUND

Global CO2 observation from satellites is very important to our understanding of global carbon cycle and climate change. More accurate measurements at a higher spatial resolution, by space-based LIDAR, will provide the needed data to identify sources and sinks of CO2 and improve climate models. Current leading concepts for space-based CO2 LIDAR include and 2mm systems and 1.5 mm. Studies indicate that 2mm systems are preferred due to its higher sensitivity to the boundary layer and lower troposphere where CO2 sources and sinks are located and where CO2 concentration has the greatest variability. One of the key enabling technologies for the 2mm CO2 LIDAR is large diameter and ultra low noise detectors.
Raytheon has developed breakthrough HgCdTe APD Detector technologies for LIDAR/LADAR applications with substantial funding from the Department of Defense (DOD) and Raytheon Internal Research and Development (IR&D) program. These HgCdTe detectors have achieved very high quantum efficiency and ultra low noise from 1.0mm to 2.5mm. In the first phase of this development, 200 mm diameter HgCdTe APD devices have been designed, fabricated, integrated into a compact liquid nitrogen dewar. In conjunction with a very low noise amplifier, detector noise of E-14 W/rt(Hz) has been demonstrated. This has been a very successful collaborative effort. Open and timely information exchanges between Raytheon and NASA LaRC and participation in the testing and characterization of the detector by NASA scientists and managers have been critical to the success of this developmental program. The focus of the second phase of this program is to optimize the performance of the APD detector by further reducing the amplifier noise and advance TRL level by demonstrating detector operation in long life-time TEC or mechanical cryogenic coolers. This demonstration is an essential next step in maturing this technology for space-based CO2 lidar applications.

3. OBJECTIVE

The objectives proposed scopes of work for the second phase of this low noise and large area APD development for CO2 LIDAR include:
1) Providing support to NASA LaRC team in the testing and integration of the prototype APD detector in a liquid nitrogen dewar into the existing NASA LaRC CO2 LIDAR test bed. NASA LaRC team plans to integrate this prototype APD detector into the CO2 LIDAR test bed and collect data to demonstrate its feasibility and sensitivity.

2) Performing amplifier re-design with a lower bandwidth (2 MHz or 5 MHz TBD by NASA) to further reduce overall APD detector subsystem noise by a factor of 2 (Goal). Testing of the current prototype APD detector indicates that the noise performance is amplifier noise limited.
3) Conducting TEC or long-life mechanical cooler packaging design and trade studies. Depending on the final optimum operating temperature of the APD device, we can either use a TEC cooler, if the APD optimum operating temperature is 200K or above, or a very compact closed cycle cooler, the standard advanced dewar assembly II (SADA II), used in Raytheon military products. The TEC cooler being considered is the Raytheon thermal weapon sight (TWS) cooler. It is at > TRL 7. It is very compact at [redacted] inches. Raytheon is manufacturing thousands of SADA II for U.S. Army. It is also at >TRL 7 with demonstrated life time of > 10 years. We want to point out that SADA II closed cycle dewar is more expensive than the TWS TEC cooler. Our proposed cost is based on the TWS TEC cooler.
4) Install one TSA with two working APDs in one TWS or one SADA II dewar. Cooler selection will be based on design and trade studies described in 3).

4. GENERAL IT SUPPORT SERVICES

General IT Support Services Performance Metrics

Performance Standard: Product quality meets customer expectations.

Performance Metrics:

- Exceeds: All deliverables are accurate and meet the requirements and acceptance criteria defined per deliverable.
- Meets: 90% of deliverables are accurate and meet the requirements and acceptance criteria. Only minor deficiencies are found that are readily correctable within the development schedule.
- Fails: Deficiencies are found that will result in schedule delays to correct.

Performance Standard: The contractor delivers products (a prototype and a final report) within cost and schedule.

Performance Metrics:

- Exceeds: The contractor delivers application to the customer prior to scheduled delivery date and under cost.
- Meets: The contractor delivers application to the customer on scheduled delivery date and within cost.
- Fails: The contractor delivers application to the customer after scheduled delivery date and/or exceeds stated cost by more than 10%.

5. SYSTEM AND APPLICATION DEVELOPMENT SERVICES

Project Title: Low Noise and Large Area APD Development for CO2 LIDAR

LaRC Software Manager:

Software Software Control Class: Low

Responsibilities of Contractor and LaRC personnel: None

Requirements:
The contractor shall:
1) Provide support to NASA LaRC team in the testing and integration of the prototype APD detector in a liquid nitrogen dewar into the existing NASA LaRC CO2 LIDAR test bed. NASA LaRC team plans to integrate this prototype APD detector into the CO2 LIDAR test bed and collect data to demonstrate its feasibility and sensitivity.
2) Perform amplifier re-design with a lower bandwidth (2 MHz or 5 MHz TBD by NASA) to further reduce overall APD detector subsystem noise by a factor of 2 (Goal). Testing of the current prototype APD detector indicates that the noise performance is amplifier noise limited.
3) Conduct TEC or long-life mechanical cooler packaging design and trade studies. Depending on the final optimum operating temperature of the APD device, we can either use a TEC cooler, if the APD optimum operating temperature is 200K or above, or a very compact closed cycle cooler, the standard advanced dewar assembly II (SADA II), used in Raytheon military products. The TEC cooler being considered is the Raytheon thermal weapon sight (TWS) cooler. It is at > TRL 7. Figure 1 shows the TWS dimensions. It is very compact at [redacted] inches. Figure 2(a) and Figure 2(b) are CAD layouts illustrating the packaging of the APD detector in the TWS III cooler. Raytheon is manufacturing thousands of SADA II for U.S. Army. It is also at >TRL 7 with demonstrated life time of > 10 years. Figure 3 is a picture of SADA II for U.S. Army. Figure 4 shows the dimensions of the SADA II closed cycle cooler. The height is [redacted] inches. A conceptual design on packaging the APD detector into the SADA II closed cycle cooler is illustrated in Figure 5. We want to point out that SADA II closed cycle dewar is more expensive than the TWS TEC cooler. Our proposed cost is based on the TWS TEC cooler.
4) Install one TSA with two working APDs in one TWS or one SADA II dewar. Cooler selection will be based on design and trade studies described in 3).

Constraints:
Funding is extremely limited and the Contractor and NASA will prioritze the requirements according to the funding available.

6. WORK-AREA SPECIFIC SERVICES

None required.

7. Exhibit A

None required.

8. SPECIAL SECURITY REQUIREMENTS

There are no special security requirements for performing the requirements of this TA. The data and reports generated, and the information used in the analyses, must be treated as ITAR sensitive. Delivery of material from this task shall be made only to NASA personnel.

9. SOFTWARE ENGINEERING PROCESS REQUIREMENTS

There are no major software developments to be performed under this TA. Any software work shall only be modifications to data or formats of inputs to analytical software that is already under configuration control.

10. JOINT REVIEW SCHEDULE

We assume the effective start date for this second phase is June 2, 2008. Support for the testing and integration of the prototype APD detector in liquid nitrogen dewar in on an as needed basis from June 2nd to September 30th with a maximum of 20 labor hours. The amplifier re-design, assembly and testing will be completed by July 15th. The TEC cooler packaging design, trade studies, cooler modification, APD installation, and testing will be completed by September 30th.

11. PERIOD OF PERFORMANCE

This TA is effective from 06/01/07 to 09/30/08

12. TECHNICAL PERFORMANCE RATING

Quality of the study and analysis. Timeliness of the preparation of final report.

Quality: 50% Timeliness: 50%

13. RESPONSE REQUIREMENTS

This Task Plan shall address the contractor's specific work plans, associated estimated labor hours, cost and schedule.

14. FUNDING INFORMATION

Funding has not been entered for this TA.

15. MILESTONES

None required.

16. DELIVERABLES

Number	Deliverable Item	Deliverable Schedule
1	Enhanced APD and TIA device and documentation	Funding permitting, as required through 9/30/2008

17. FILE ATTACHMENTS

Others1